

Claims

- [c1] 1. A method for fabricating a deep trench capacitor, comprising:
- providing a substrate, having a deep trench formed therein, a doped region formed at a bottom of the deep trench, a capacitor dielectric layer formed over a surface of the bottom of the deep trench, and a first conductive layer formed over the capacitor dielectric layer;
- forming a collar oxide layer on sidewalls of the deep trench that are not covered by the first conductive layer;
- forming a material layer within the deep trench, covering the first conductive layer, and exposing a portion of the collar oxide layer;
- removing the exposed portion of the collar oxide layer for exposing the substrate at sidewalls of the top of the deep trench;
- removing the material layer; and
- forming a second conductive layer, covering the first conductive layer and the collar oxide layer, the second conductive layer contacting the substrate at the sidewalls of the top of the deep trench.
- [c2] 2. The method for fabricating a deep trench capacitor of

claim 1, wherein the removal rate of the material layer is different from that of the collar oxide layer.

[c3] 3. The method for fabricating a deep trench capacitor of claim 1, wherein the material of the material layer is different from that of the first conductive layer.

[c4] 4. The method for fabricating a deep trench capacitor of claim 1, wherein the material layer is a photoresist layer.

[c5] 5. The method for fabricating a deep trench capacitor of claim 1, wherein the step of forming the collar oxide layer on the sidewalls of the deep trench that are not covered by the first conductive layer comprises:
forming an oxide layer over the substrate and the surface of deep trench; and
etching back the oxide layer for forming the collar oxide layer on the sidewalls of the deep trench.

[c6] 6. The method for fabricating a deep trench capacitor of claim 1, wherein the steps of forming the material layer, covering the first conductive layer, and exposing the portion of the collar oxide layer comprise:
forming the material layer over the substrate, filling the deep trench and covering the first conductive layer and the collar oxide layer; and
removing a portion of the material layer for exposing the

portion of the collar oxide layer.

- [c7] 7. The method for fabricating a deep trench capacitor of claim 6, wherein the step of removing the portion of the material layer for exposing the portion of the collar oxide layer comprises:
performing a chemical mechanical polish process for removing a portion of the material layer; and
performing an etching process, removing another portion of the material layer for exposing the portion of the collar oxide layer.
- [c8] 8. The method for fabricating a deep trench capacitor of claim 1, wherein the step of removing the exposed portion of the collar oxide layer comprises a wet etching process.
- [c9] 9. The method for fabricating a deep trench capacitor of claim 1, wherein the material of the first conductive material comprises polysilicon.
- [c10] 10. The method for fabricating a deep trench capacitor of claim 1, wherein the material of the second conductive layer comprises polysilicon.
- [c11] 11. The method for fabricating a deep trench capacitor of claim 1, wherein the steps of forming the deep trench within the substrate, forming the doped region at the

bottom of the deep trench, forming the capacitor dielectric layer over the surface of the bottom of the deep trench, and forming the first conductive layer over the capacitor dielectric layer comprise:

forming a mask layer on the substrate;

patterning the substrate by using the mask layer as an etching mask for forming the deep trench within the substrate;

forming a doped layer on the mask layer and the surface of the deep trench;

removing a portion of the doped layer, and remaining the doped layer at the bottom of the trench;

performing a thermal process for diffusing ions within the doped layer into the substrate and forming the doped region;

removing the doped region;

forming a dielectric layer over the mask layer and the surface of the deep trench;

filling the first conductive layer within the deep trench, but not completely filling the deep trench; and

removing a portion of the dielectric layer and a remaining portion of the dielectric layer remain covered by the first conductive layer for forming the capacitor dielectric layer.

[c12] 12. A deep trench capacitor, comprising:

a substrate, having a deep trench therein;
a doped region, formed within the substrate at the bottom of the deep trench;
a capacitor dielectric layer, formed on the surface of the bottom of the deep trench;
a first conductive layer, formed over the capacitor dielectric layer;
a collar oxide layer, formed on sidewalls of the top of the deep trench, the substrate at sidewalls of the top of the deep trench exposed; and
a second conductive layer, formed within the deep trench, covering the first conductive layer and the collar oxide layer, the second conductive layer contacting the substrate at the sidewalls of the top of the trench.

[c13] 13. The deep trench capacitor of claim 12, wherein the material of the first conductive layer comprises polysilicon.

[c14] 14. The deep trench capacitor of claim 12, wherein the material of the second conductive layer comprises polysilicon.